

Argonne National Laboratory
Standard Operating Procedures For
Laser Controlled Area, XOR beamline
Building 433, 7-ID-D
version 5.0 (September 2004)

Prepared by: Eric Landahl

LCA Supervisor:

<u>Eric Landahl</u>	(630-252-0278)	
Name Printed	Signature	Date

ESH/QA Coordinator:

<u>Edmund Chang</u>		
Name Printed	Signature	Date

ANL-E Laser Safety Officer or Deputy Laser Safety Officer:

<u>Bruce Murdoch</u>	(252-4905)	
Name Printed	Signature	Date

AOD Division Director:

<u>William Ruzicka</u>		
Name Printed	Signature	Date

Introduction

The laser controlled area (LCA) covered in this document consists of hutch 7-ID-D at the Advanced Photon Source. The room contains a Class IV Ti:Sapphire laser system.

LCA SUPERVISOR

Eric Landahl Office: (630)252-0278 elandahl@anl.gov
Pager: (630)218-3342
LCA Phone Number (7ID-D): (630)252-1807

AUTHORIZED USERS

No person is allowed to operate the laser system in the LCA unless **all** three of the following requirements are met:

- (1) Permission from the LCA Supervisor, Eric Landahl;
- (2) Completion of the laser user eye examination approved by ESH Medical Department and the Laser Safety Training;
- (3) Completion of appropriate safety training from APS and MHATT-CAT, as well as an approval from the APS User's Office to have an access to the experimental floor.

The names of authorized personnel will be posted at the LCA and Appendix B.

SCIENTIFIC COLLABORATORS

A Scientific Collaborator is allowed in the LCA for scientific work or laser alignment only if approved by the LCA supervisor and the above conditions are met. Everybody in the LCA needs to wear proper eyewear approved by the LCA supervisor when the laser beams are accessible.

Spectators are only allowed to enter the LCA in the presence of authorized personnel if the laser is off or the laser shutters are closed and no laser light is accessible.

Both scientific collaborators and spectators require film badges issued by the APS.

Description and Normal Laser Operation

SYSTEM DESCRIPTION:

The laser system inside the LCA consists of two parts as described in Table 1.: A Ti:Sapphire oscillator (2) pumped by a frequency doubled Nd:YVO laser (1. Not all parts individually constitute independent lasers, however the combined system constitutes a Class IV laser. Its output is the output of the oscillator described in item 2 below; all other beams described below are internal to the combined system and are not accessible during normal operation of the system.

The laser system can be on, shuttered, or off. In the on state, laser beams are accessible and only authorized personnel is allowed in the room. In the shuttered state, the laser is powered on, but physically prevented from emitting light; all laser light is physically contained inside the system and cannot be accessed. In the off state, the laser power is off and no laser light is produced.

TABLE 1.: LASER INVENTORY

1. CW Diode Pumped Nd:YVO Laser

ANL ESH IHID # 10395 Serial # V5-A6795
Manufacturer: Coherent Model: Verdi
Output: 532nm, CW
Beam diameter: 2.25mm TEM₀₀ Beam divergence: 0.5mrad
Average power: 5W

2. Ti:Sapphire Oscillator

ANL ESH IHID # 10396 Serial # 063
Manufacturer: K&M Labs Model: short pulse oscillator
Output: 750-850nm, pulsed (repetition rate 88 MHz)
Pulse width (FWHM): 20fs
Beam diameter: 0.8mm Beam divergence: 1 mrad
Average power: <500mW pulsed, <1.5W in CW mode

Note: The oscillator (item 2) does not produce any output radiation if its pump laser (item) is shuttered or not in operation.

The overall system diagram is show in Appendix A. The output of item 1 is used to pump the oscillator item 2 directly. Beam 1 will be enclosed and shielded and will not be accessible or be manipulated during normal operation. Item 2 will produce anear-IR output beam for use, which is the only accessible beam during normal operation.

EYEWEAR:

The eyewear worn for standard laser operation should provide an optical density (OD) of at least 4 at wavelengths of 750-850nm for protection against the Ti:Sapphire beams. The eyewear for alignment of the laser which exposes the pump beams should additionally provide ODe2 at 514-532nm and 1054-1064nm, for protection against the green and residual IR laser beams from the Neodymium pump lasers.

Standard protective laser eyewear will be provided at the entrance to the hutch 7-ID-D. (The eyewear provided for Ti:Sapphire has ODe7 at 695-1200nm. The eyewear provided for Neodymium wavelengths has ODe2 or ODe6 at 514-532nm and 1054-1064nm.)

NOTE: For applications utilizing higher harmonics of the Ti:Sapphire laser the following eyewear must be used. When using 400nm light (2nd harmonic) the use of the standard eyewear for Neodymium (ODe6) has sufficient coverage to block 400nm radiation. For laser applications requiring UV light (<280nm, 3rd+ harmonic) the standard issue Ti:Sapphire eyewear is required.

All laser protective eyewear will be inspected quarterly and the results will be recorded in a log sheet attached at the end of this SOP.

LASER HAZARDS:

The Class IV lasers in 7-ID-D produce visible (green) and invisible radiation (infrared around 800nm) with sufficient power or energy to cause retinal or other injury to the eye, in both direct or specularly reflected beams. Diffuse reflections of the beam can be hazardous. The lasers also have the potential to cause burns on the skin or ignite flammable material.

OTHER HAZARDS:

High voltage:
110VAC, single phase, 100W (power to items 1 and 2).

Methods to control hazards associated with operation of the laser

The procedures for alignment of the laser subsystems are documented in the manuals for the K&M Labs Ti:Sapphire oscillator. During normal operation, Ti:Sapphire laser goggles must be worn; during laser alignment involving exposure of the pump lasers beams, additional goggles for Neodymium laser protection must be worn (see eyewear section above). IR viewers and IR viewing cards will be provided to view the laser beams while wearing eye protection. The beam path will be confined to a plane below the eye level for operators in a standing position.

An additional light shield will be installed towards the entrance of the laser enclosure. The laser eyewear will be inspected quarterly and the results of the inspection will be recorded in the table attached at the end of this document.

ADDITIONAL CONTROL OF LASER HAZARDS

1. LASER HAZARD WARNING SIGNS are posted above the entrance door to the 7-ID-D and will be illuminated when the laser is on.

2. An INTERLOCK SYSTEM is installed at the entrance doors to the LCA, which automatically closes an internal shutter of the laser system upon an entry to the LCA by unauthorized personnel. A timed defeat switch is installed at the entrance for the authorized operators to exit/enter the LCA without interrupting laser experiments. Figure 2 shows the location of the interlocks and Figure 3 shows a summary of the interlock actions.

The interlock system will be inspected quarterly per the actions in Figure 3, and the results will be recorded in the log sheet attached at the end of this document. The door switch in 7-ID-D will be inspected to see if they fulfill the expected function.

3. LASER SAFETY GLASSES or other eye protection devices which provide sufficient attenuation of hazardous light intensities to prevent eye injury to the wearer shall be worn whenever such hazardous light intensities are present. Laser safety glasses will be provided at the entrance to the LCA. They will be inspected quarterly and the results will be recorded in the log sheet attached at the end of this document.

4. LASER BEAM SHIELDS are made of non-combustible laser beam stops, which will not create hazardous light airborne particulate matter when in use. The beam path is confined to a plane well below eye level and shielded as much as practicable.

5. UNAUTHORIZED OPERATION The Laser Power Supply Keys for the class IV laser will be switched to the disabled state while the laser is off and unattended, and the power supply circuit breaker will be shut off. The master interlock shutter control key will be switched off in the disabled state. The keys will remain under administrative control while the laser is not in operation to prevent unauthorized operation of the laser.

6. EMERGENCY LASER CUT-OFF SWITCH (Class 4) Two panic switches are marked by large signs in red. These switches insert all laser shutters.

STANDARD OPERATION PROCEDURES FOR HANDLING POSTULATED AND CREDIBLE ABNORMAL AND EMERGENCY CONDITIONS

In the events of:

1. Breakdown of a high voltage system Call 911 if help is needed, shut off power at main circuit breaker, and report to the LCA Supervisor.

2. Laser burns to eyes and/or skin Call 911, shut laser system down, report to LCA Supervisor and to the APS floor coordinator.

3. Laser coolant (water) accidentally discharged into the environment Shut laser system down, report to the LCA supervisor, and report to the APS floor coordinator to have the discharge cleaned up.

4. Fire and tornado In case of fire, call 911, quickly evacuate from the LCA and pull the nearest fire alarm. In case of tornado, evacuate immediately to the nearest tornado shelter (the restrooms at Building 433).

METHODS TO CONTROL HAZARDS ASSOCIATED WITH ALIGNMENT OF THE LASER AND THE LASER BEAM IT PRODUCES

During alignment of the laser in 7-ID-D, or operation which requires the presence of an operator, the automatic door to the hutch is kept open. Laser shielding (a curtain for shielding the laser beam) and a barrier sensor are installed at the 7-ID-D automatic door entrance which will not hinder the entry/exit for the operators. Other unauthorized personnel are not allowed to enter 7-ID-D during operation of the laser and are warned by the laser warning lights above the hutch door and a warning sign on the laser curtain. If the barrier sensor is blocked due to an entry through the curtain or the curtain is not closed in place, the laser shutters inside 7-ID-D will close, stopping any laser beam. Once inside the curtain, the authorized laser operator will be able to reopen the shutter by activating the laser shutter switch inside 7-ID-D. Light shielding is provided along the laser beam path inside 7-ID-D as much as possible.

Appropriate laser goggles must be worn in 7-ID-D at any time exposure to the laser beam is possible.

Alignment of the laser components will be performed with all beams turned to the minimum power necessary for the procedure. After alignment, all laser beams between laser components will be shielded from view and access by beam tubes and permanent shields as much as possible. Laser

beam shields along the path of the output beam from the final amplifier will be installed where possible to minimize the possibility of laser beam exposure.

APPENDIX A

LASER TABLE LAYOUT

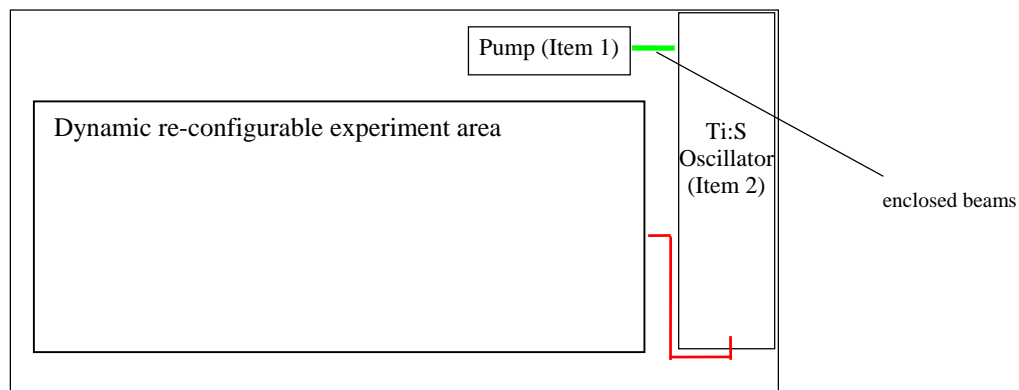


FIGURE 1

Floor Plan

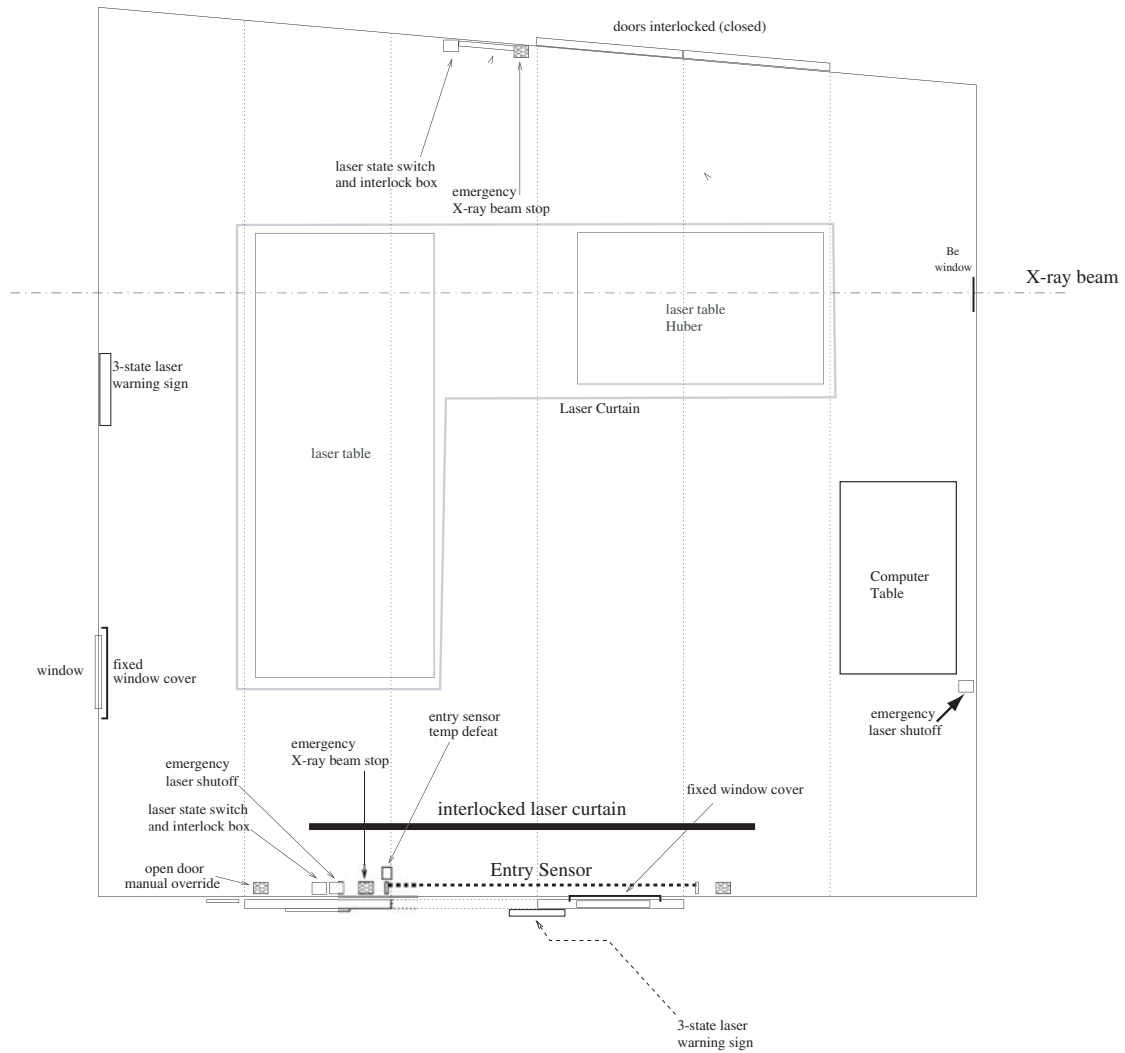


FIGURE 2

Interlock State	Emergency Laser Shutoff	Master Key	Back Door	Curtain	Entry Sensor *	Lid	State Request		
							1	2	3
3 Danger: Beams Accessible	1	2	1	1	2	—	1	2	—
2 Warning: Laser Energized	1	—	1	1	1/—†	1	1	—	3§
1 No Hazard: laser off	—	—	—	—	—	—	—	2§	—

In state **3**., all shutters enabled.
In state **2**., only the Verdi is enabled—all laser light is contained.
In state **1**., all shutters are disabled.

* The action of the entry sensor may be temporarily overridden by the timed bypass switch.
† System drops to state 1 if the Master Key is out, otherwise no action is taken.
§ Master Key is required to raise state.

In addition, all action that takes the system from state **3** to state **2** requires that the conditions for state 2 are met, otherwise the system will drop to state 1.

FIGURE 3

(AUTHORIZED USERS, LASER EYE WEAR INSPECTION LOG, LASER INTERLOCK INSPECTION LOG)

List all Authorized Users, include their badge number. Users should sign the document to verify that they have read and understand the Standard Operating Procedure for the LCA.

[illegible]

[illegible]

Laser Interlock Inspection Log for 7-ID-D

Date _____

Result

Inspector

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.